du Treil, Lundin & Rackley, Inc.
Consulting Engineers

TECHNICAL EXHIBIT

PREDICTED IMPACT
OF NEW FM TRANSLATOR ANTENNA
ON NEARBY AM RADIO STATIONS
TRANSLATOR W253CY
CARY, NORTH CAROLINA

March 22, 2019

CH 253 98.5 MHZ 0.15 KW 134 M (AGL)

PREDICTED IMPACT
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ON NEARBY AM RADIO STATIONS
TRANSLATOR W253CY
CARY, NORTH CAROLINA

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Executive Summary – W253CY

Information regarding a study of the potential impact of the new W253CY FM translator transmitting antenna on the antenna patterns of nearby AM stations WPTF and WQDR is included herein. The new FM antenna is authorized by construction permit number BMPFT-20181109ADB. Conditions 4 and 5 of the construction permit address its requirements for protecting the nondirectional radiation pattern of WQDR and the nighttime directional antenna pattern of WPTF from disturbance, respectively.

The FM translator antenna will be side mounted on the tower that is used for nondirectional operation by WPTF in the daytime. The tower is not a part of the WPTF nighttime directional antenna system. The tower is detuned at the WQDR frequency, 570 kilohertz, and the WPTF frequency, 680 kilohertz, with a detuning network that is connected to ground across its base during the pertinent hours of operation for both stations. The detuning scheme has been in place since the WQDR and WPTF facilities were licensed together at the site and it will remain unchanged.

MoM Modeling of Before and After Effects on WQDR and WPTF

Method of Moments modeling of all three towers at the transmitter site was performed to assess the impact of the new FM antenna on WQDR and WPTF, pursuant to the CP conditions. The WPTF daytime tower, which will support the new FM antenna, and the two towers of the WPTF nighttime directional array - one of which is also used by WQDR – were included in the model.

The relative positions of the towers were determined from their ASR geographic coordinate information on file with the FCC, verified - in the cases of the two towers of the WPTF nighttime directional antenna system - with the theoretical parameters of the antenna patttern. Tower 1 of the WPTF nighttime directional antenna system, which is also employed for nondirectional operation by WQDR, is registered with the FCC with ASR number 1007884. Its base is located 44.2 meters at an azimuth of 161.4 degrees true from the center of the two-tower WPTF nighttime directional antenna array. Tower 2 of the WPTF nighttime array, ASR number 1007883, is located 44.2 meters at an azimuth of 341.4 degrees true from the two-tower array center. The WPTF nondirectional daytime tower, ASR number 1007885, is located 118.0 meters from the center of the WPTF two-tower nighttime array at an azimuth of 121.7 degrees true. The models used this positional information for the three towers that were studied.

The towers were modeled utilizing the methodology specified in 47 CFR 73.151(c), with thin wire assumptions, in accordance with the requirements of 47 CFR 1.30002(c). All were modeled at the electrical heights specified for them in the FCC's engineering database. The detuned tower that will support the FM antenna was modeled with a radius based on the 20 inch diameter pole which constitutes the upper 82 feet of the WPTF

daytime tower's structure, in order to accurately account for whatever perturbation of the overall current distribution results from the added capacitance of the FM antenna where it will be mounted on the pole.

The FM antenna was simulated by increasing the radius of the wire section representing the area where it will be side mounted on the pole to a value based on the equivalent horizontal plane area occupied by the support pole plus the FM antenna. A total vertical length greater than the FM antenna's height was modeled with the increased wire radius to simulate not-to-exceed conditions. Other antennas on the tower were not simulated so as to allow conclusive analysis of the singular effects of adding the FM antenna in question without any masking effects. Expert MININEC Broadcast Professional Version 14.5 was used for the modeling.

In order to avoid significant proximity effects on the far-field radiation values having to do with the geometry of the three towers, they were calculated at a distance of 10 kilometers and then converted to their corresponding values of unattenuated field strength at 1 kilometer to comport with the standard for defining AM antenna radiation patterns. For worst-case radiation calculations, no ground loss was assumed for the modeled towers.

Construction Permit Condition 4

To evaluate the effect of the FM translator antenna, the modeling considered the circularity of the WQDR nondirectional radiation pattern.

To examine the situation with regard to the potential for effects on the WQDR far field radiation pattern, a Method of Moments computer study was run using a model of the nondirectional tower in accordance with the requirements of Section 1.30002(c) of the FCC Rules. Two models were run – one with the existing detuned tower having no antenna and another with the new W253CY translator antenna side mounted on it.

The before-after Method of Moments ("MoM") analysis presented herein demonstrates that the W253CY antenna will have no significant effect on the detuned condition of the tower insofar as the WQDR nondirectional antenna pattern is concerned. The calculated unattenuated field strength levels at one kilometer on six equally-spaced radials are within the required +/- 2.0 dB limits specified in 47 CFR 1.30002(a).

Construction Permit Condition 5

To evaluate the effect of the FM translator antenna, the modeling considered the shape of the WPTF nighttime directional radiation pattern.

To examine the situation with regard to the potential for effects on the WPTF far field radiation pattern, a Method of Moments computer study was run using a model of the nighttime array with voltage sources calculated to produce the authorized directional antenna pattern in accordance with the requirements of Section 1.30002(c) of the FCC

Rules. Two models were run – one with the existing detuned tower having no antenna and another with the new W253CY translator antenna side mounted on it.

To evaluate the effect of the FM translator antenna, the modeling considered the changes in far-field radiation in the specified monitor point directions of the WPTF license. This is in keeping with the radial azimuth specifications of Section 1.30002(f) of the FCC Rules when before-and-after field strength measurements are run.

As can be seen from the before-after tabulation of Item 1, the installation of the W253CY FM translator antenna on the WPTF daytime nondirectional tower will have no material impact on the WPTF nighttime directional antenna pattern. The far-field radiation pattern will remain well within the licensed standard pattern. No radiation level change capable of being proven with field strength measurements, given the rated accuracy of field strength meters, was found.

Conclusion

The before-after Method of Moments ("MoM") analysis presented herein demonstrates that the installation of the new W253CY antenna will have no significant effect on the detuned condition of the tower insofar as the WQDR nondirectional antenna and the WPDF nighttime directional antenna system are concerned.

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March 22, 2019

Item 1

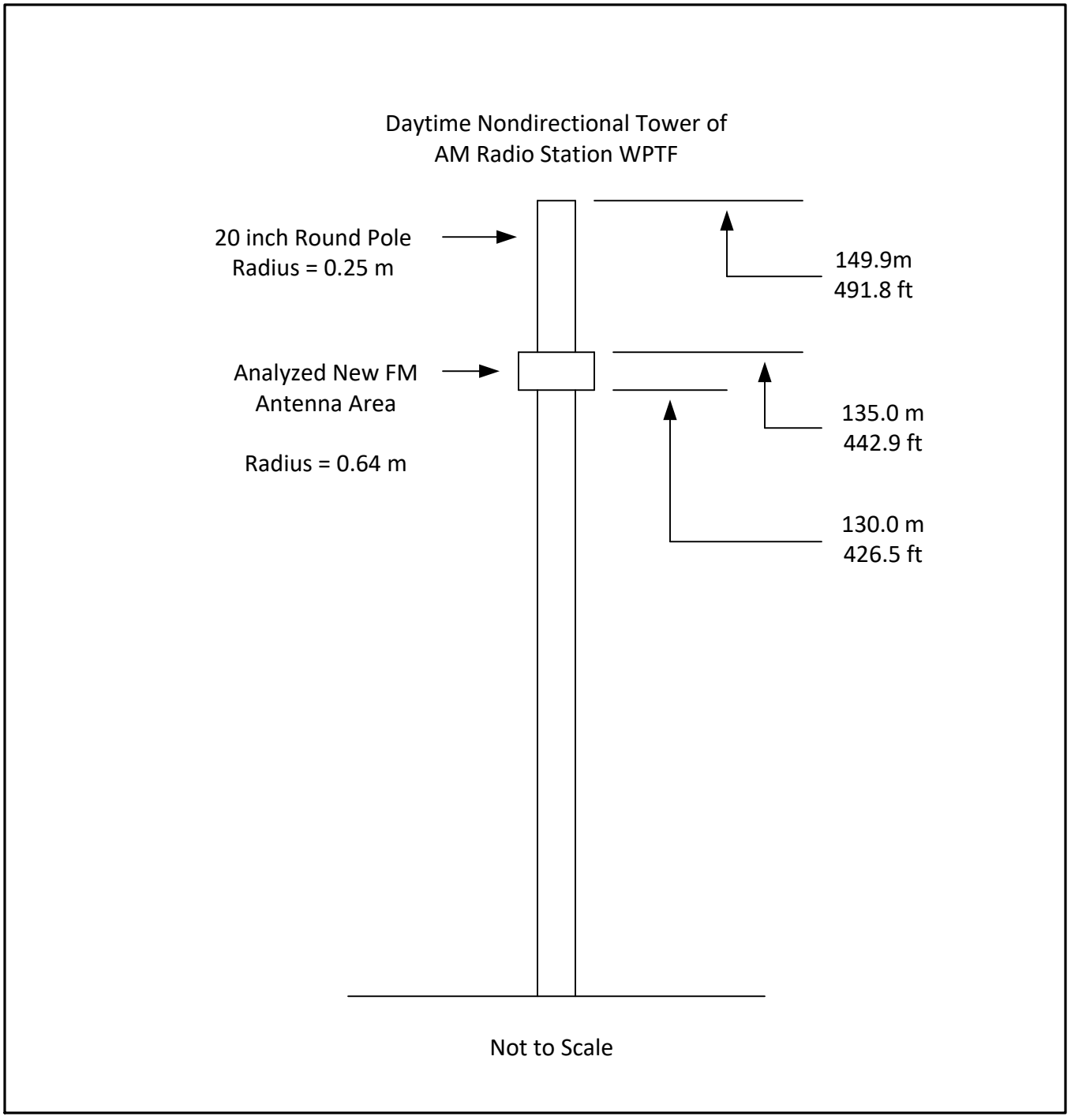
Tabulation of Before and After Radial Field Strengths – W253CY

WQDR Nondirectional

Radial (Deg. T.)	Standard (mV/m)	Before (mV/m)	After (mV/m)	Increase/Before		
				Ratio	Percent	dB
0	N/A	284.7	284.9	1.001	+0.1	+0.01
60	N/A	284.7	284.4	0.999	-0.1	-0.01
120	N/A	284.7	284.3	0.999	-0.1	-0.01
180	N/A	284.7	284.4	1.000	-0.1	-0.01
240	N/A	284.7	284.5	0.999	-0.1	-0.01
300	N/A	284.7	285.2	1.002	+0.2	+0.01

WPTF Night DA

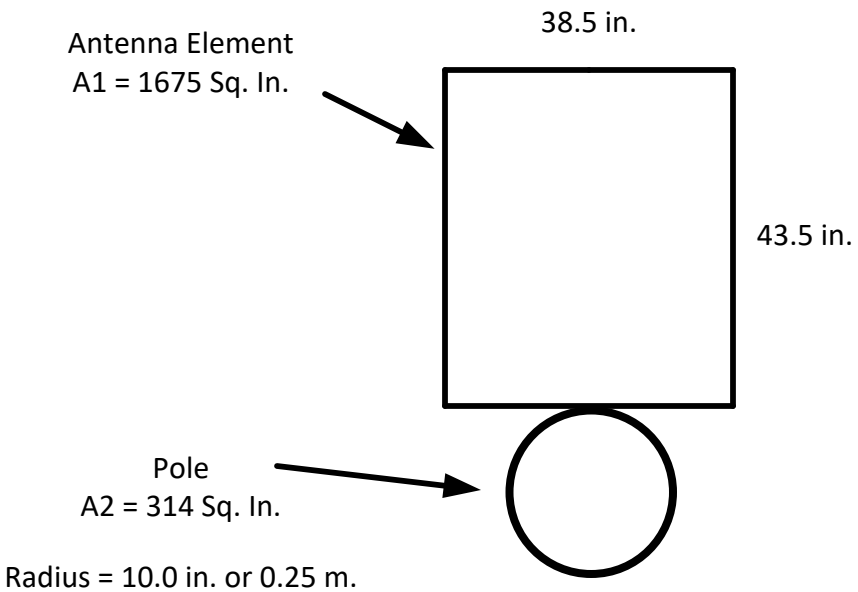
Radial (Deg. T.)	Modified Standard (mV/m)	Before (mV/m)	After (mV/m)	Increase/Before		
				Ratio	Percent	dB
37.2	189.9	161.1	164.0	1.018	+1.8	+0.16
285	189.9	159.8	159.1	0.995	-0.5	-0.04
341.4	1287.5	1147.2	1146.9	1.000	0.0	0.00



SKETCH SHOWING DETUNED TOWER MODELING ASSUMPTIONS

TRANSLATOR W253CY
CARY, NORTH CAROLINA

du Treil, Lundin & Rackley, Inc.



Not to Scale

A1 + A2 = 1989 Sq. In.
Equivalent Circle Radius = 25.2 in. or 0.64 M

SKETCH SHOWING FM ANTENNA MODELING ASSUMPTIONS

TRANSLATOR W253CY
CARY, NORTH CAROLINA

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du Treil, Lundin & Rackley, Inc.

WQDR Modeling Without the New FM Antenna

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MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = .57 MHz

tower	field ratio magnitude	phase (deg)
1	1.	0
2	0	0
3	0	0

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	342.758	297.7	5.7687	2.3
21	129.27	345.2	.182996	79.5
41	158.585	349.2	.291301	85.8

Sum of square of source currents = 66.7924
Total power = 841.9 watts

NOTE: The array synthesis calculations (above) were performed to solve for the base voltage drives required to produce the specified field parameters for the tower of the nondirectional radiation pattern with the WPTF daytime tower, on which the new antenna is to be installed, detuned and without the new antenna. The power for the model was set to produce the horizontal plane theoretical RMS efficiency shown in the FCC engineering database for the licensed power. The modeled power is lower than the licensed power because the theoretical RMS efficiency includes assumed losses and the MoM model does not. The following information is for the model without the new antennas for the "before" case.

GEOMETRY
Dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	44.2	161.4	0	.25	20
		44.2	161.4	112.8		
2	none	44.2	341.4	0	.25	20
		44.2	341.4	112.8		
3	none	118.	121.7	0	.25	30
		118.	121.7	149.9		

Number of wires = 3
current nodes = 70

Individual wires	wire	minimum value	wire	maximum value
segment length	3	4.99667	1	5.64
segment/radius ratio	3	19.9867	1	22.56
radius	1	.25	1	.25

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	.57	0	1	9.5E-03	.0107232

Sources

source	node	sector	magnitude	phase	type
1	1	1	484.732	297.7	voltage
2	21	1	182.815	345.2	voltage
3	41	1	224.273	349.2	voltage

RADIATION PATTERN rms
geographic coordinate system

Radial distance (meters) = 10,000.
Frequency = .57 MHz
Input power = 841.9 watts
Efficiency = 100. %

elevation angle	azimuth angle	E-theta mag (v/m)	E-theta phase (deg)	E-phi mag (v/m)	E-phi phase
0	0	.0284702	61.3	0	0
0	60.	.0284702	84.	0	0
0	120.	.0284702	112.7	0	0
0	180.	.0284702	118.7	0	0
0	240.	.0284702	96.	0	0
0	300.	.0284702	67.3	0	0

NOTE: The radiation values were calculated for a distance of 10 kilometers, to minimize array element proximity effects, and must be multiplied by 10 to obtain their equivalent inverse distance unattenuated values at 1.0 kilometer.

WQDR Modeling with the New FM Antenna

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VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	342.758	297.7	5.7687	2.3
21	129.27	345.2	.182996	79.5
41	158.585	349.2	.291301	85.8

Sum of square of source currents = 66.7924
Total power = 841.9 Watts

NOTE: The above base voltage drives were calculated to produce the specified field parameters for the tower of the WQDR nondirectional radiation pattern with the WPTF daytime tower, on which the new FM antenna is to be installed, detuned and without the new antenna. The power for the model was set to produce the horizontal plane theoretical RMS efficiency shown in the FCC engineering database for the licensed power. The modeled power is lower than the licensed power because the theoretical RMS efficiency includes assumed losses and the MoM model does not. The following information is for the model with the new antenna installed on the WPTF daytime tower and the same base voltages for the "after" case.

GEOMETRY
Dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	44.2	161.4	0	.25	20
		44.2	161.4	112.8		
2	none	44.2	341.4	0	.25	20
		44.2	341.4	112.8		
3	none	118.	121.7	0	.25	30
		118.	121.7	130.		
4	none	118.	121.7	130.	.64	1
		118.	121.7	135.		
5	none	118.	121.7	135.	.25	3
		118.	121.7	149.9		

Number of wires = 5
current nodes = 74

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	4.33333	1	5.64
segment/radius ratio	4	7.8125	1	22.56
radius	1	.25	4	.64

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	.57	0	1	8.24E-03	.0107232

Sources

source	node	sector	magnitude	phase	type
1	1	1	484.734	297.7	voltage
2	21	1	182.82	345.2	voltage
3	41	1	224.273	349.2	voltage

RADIATION PATTERN rms
geographic coordinate system

Radial distance (meters) = 10,000.
Frequency = .57 MHz
Input power = 841.9 watts
Efficiency = 100. %

elevation angle	azimuth angle	E-theta mag (v/m)	phase (deg)	E-phi mag (v/m)	phase
0	0	.0284858	61.4	0	0
0	60.	.0284444	84.	0	0
0	120.	.0284282	112.7	0	0
0	180.	.0284427	118.7	0	0
0	240.	.0284999	96.	0	0
0	300.	.0285212	67.4	0	0

NOTE: The radiation values were calculated for a distance of 10 kilometers, to minimize array element proximity effects, and must be multiplied by 10 to obtain their equivalent inverse distance unattenuated values at 1.0 kilometer.

WPTF Modeling Without the New FM Antenna

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MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = .68 MHz

tower	field ratio magnitude	phase (deg)
1	.925	-140.
2	1.	0
3	0	0

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	2,101.09	289.2	28.0003	222.6
21	972.299	60.5	32.465	1.6
41	1,409.96	242.6	3.29647	334.3

Sum of square of source currents = 3,697.72
Total power = 39,432.

NOTE: The array synthesis calculations (above) were performed to solve for the base voltage drives required to produce the specified field parameters for the two towers of the nighttime directional radiation pattern with the WPTF daytime tower, on which new antenna is to be installed, detuned and without the new antenna. The power for the model was set to produce the horizontal plane theoretical RMS efficiency shown in the FCC engineering database for the licensed power. The modeled power is lower than the licensed power because the theoretical RMS efficiency includes assumed losses and the MoM model does not. The following information is for the model without the new antennas for the "before" case.

GEOMETRY
Dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	44.2	161.4	0	.25	20
		44.2	161.4	112.8		
2	none	44.2	341.4	0	.25	20
		44.2	341.4	112.8		
3	none	118.	121.7	0	.25	30
		118.	121.7	149.9		

Number of wires = 3
current nodes = 70

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	4.99667	1	5.64
segment/radius ratio	3	19.9867	1	22.56
radius	1	.25	1	.25

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.68	0	1	.0113333	.0127925

Sources

source	node	sector	magnitude	phase	type
1	1	1	2,971.39	289.2	voltage
2	21	1	1,375.04	60.5	voltage
3	41	1	1,993.98	242.6	voltage

RADIATION PATTERN rms
geographic coordinate system

Radial distance (meters) = 10,000.
Frequency = .68 MHz
Input power = 50,000. watts
Efficiency = 100. %

elevation	azimuth	E-theta		E-phi	
angle	angle	mag (v/m)	phase (deg)	mag (v/m)	phase
0	37.2	.0161115	117.3	0	0
0	285.	.0159822	109.3	0	0
0	341.4	.114722	192.3	0	0

NOTE: The radiation values were calculated for a distance of 10 kilometers, to minimize array element proximity effects, and must be multiplied by 10 to obtain their equivalent inverse distance unattenuated values at 1.0 kilometer.

WPTF Modeling with The New FM Antenna

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MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = .68 MHz

tower	field ratio magnitude	phase (deg)
1	.925	-140.
2	1.	0
3	0	0

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	2,101.09	289.2	28.0003	222.6
21	972.299	60.5	32.465	1.6
41	1,409.96	242.6	3.29647	334.3

Sum of square of source currents = 3,697.72
Total power = 39,432. Watts

NOTE: The above base voltage drives required to produce the specified field parameters for the two towers of the nighttime directional radiation pattern, with the WPTF daytime tower detuned and without the new antenna, were calculated for the “before” case. The power for the model was set to produce the horizontal plane theoretical RMS efficiency shown in the FCC engineering database for the licensed power. The modeled power is lower than the licensed power because the theoretical RMS efficiency includes assumed losses and the MoM model does not. The following information is for the model with the new antenna installed on the tower and the same base voltage drives for the “after” case.

GEOMETRY
Dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	44.2	161.4	0	.25	20
		44.2	161.4	112.8		
2	none	44.2	341.4	0	.25	20
		44.2	341.4	112.8		
3	none	118.	121.7	0	.25	30
		118.	121.7	130.		
4	none	118.	121.7	130.	.64	1
		118.	121.7	135.		
5	none	118.	121.7	135.	.25	3
		118.	121.7	149.9		

Number of wires = 5
current nodes = 74

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	3	4.33333	1	5.64
segment/radius ratio	4	7.8125	1	22.56
radius	1	.25	4	.64

ELECTRICAL DESCRIPTION

Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.68	0	1	9.83E-03	.0127925

Sources

source	node	sector	magnitude	phase	type
1	1	1	2,101.09	289.2	voltage
2	21	1	972.299	60.5	voltage
3	41	1	1,409.96	242.6	voltage

RADIATION PATTERN rms
geographic coordinate system

Radial distance (meters) = 10,000.
Frequency = .68 MHz
Input power = 39,432. watts
Efficiency = 100. %

elevation	azimuth	E-theta		E-phi	
angle	angle	mag (v/m)	phase (deg)	mag (v/m)	phase
0	37.2	.0163991	117.3	0	0
0	285.	.015907	109.1	0	0
0	341.4	.114692	192.3	0	0

NOTE: The radiation values were calculated for a distance of 10 kilometers, to minimize array element proximity effects, and must be multiplied by 10 to obtain their equivalent inverse distance unattenuated values at 1.0 kilometer.